THE EXPLOSIVES ENGINEER

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Forerunner of Progress in Mining, Quarrying, Construction

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Views and opinions expressed by the authors of articles in this publication are their own, and they do not necessarily represent those of the publisher.

The construction of a breakwater at the southwest corner of the Island of Zapara, off the coast of Venezuela, requires 1,200,000 tons of broken rock for use as riprap. The only available source for a supply of suitable rock in the area is on nearby Toas Island. This rock is a complex formation, varying from a schistose type to limestone over shale, with numerous extrusive intrusions.

A quarry was opened on Toas Island by a contractor known locally as "Conticca," and the required tonnage of riprap is being produced by blasting a series of tunnels and benches. A description of the materials and methods in use at the quarry is presented in the article beginning on page 39.

* * *

A radical diversion from the usual mining practice, increasing the depth of rooms from 300 ft. to 2,100 ft., increased the output per unit per man more than 50 per cent in the Reel's Cove mine in Tennessee.

After the coal in a working place has been undercut, a round of holes for blasting is drilled 7 ft. deep on 7-ft. centers. Each drill hole is loaded with two or three cartridges of permissible powder. Experiments proved that the firing of the explosives charge in the center hole first produces a better grade of coal, easier handling for the mechanical loading equipment, a better rib in the room, and no slabbing.

For more details about this modern coal-mining operation, please turn to page 43.

* * *

The mammoth construction program of the U. S. Bureau of Reclamation in the Columbia Basin in east central Washington is rapidly passing from its spectacular stage. A guaranteed supply of water for the irrigation of 2,500,000 acres of desert land has brought about rapid farmland development and heavily increased crop production in the area.

The construction of roads and bridges to provide travelways between the expanding farms and towns is proceeding at a rapid pace. As a result, large quantities of industrial explosives are being used in reducing heavy rock cuts to grade.

A summary of the activities during this period of transition and growth in the area may be found on page 48.

* * *

For a quarter of a century, farmers along Pone Run, east of Midvale, Ohio, were unable to utilize 75 acres of land on their properties. The acreage, covered with creek-bottom muck, trees, heavy brush, and overflow water from an old clogged-up ditch, was useless for farming purposes. The blasting of a series of ditches with dynamite quickly converted the 75 acres to fertile soil with a minimum expenditure of money and time.

An article covering the details of how this ditch-blasting project was accomplished successfully begins on page 53.

* * *

To provide additional air for its underground mining activities, Ames Mining Company sunk a 13.5-ft.-diameter shaft 392 ft. deep into an existing entry in the mine. The drilling and blasting of alternate series of sandstone, sandy shale, and shale posed many difficult problems. A summary of work procedures on this shaft-sinking project is included in the article beginning on page 55.

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WHERE EXPLOSIVES RESEARCH PAYS OFF

About 487,000,000 tons of coal were mined last year to provide fuel for America's electric utilities, coke ovens for producing steel and cement, and railroads. Mining that tonnage economically and efficiently required nearly a quarter billion pounds of industrial explosives.

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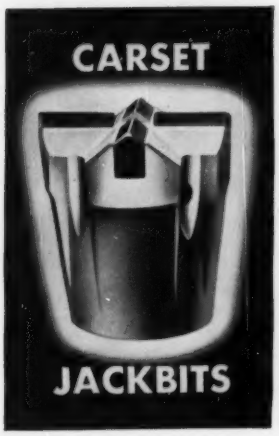

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LEO FREDERICK REINARTZ

Leo Frederick Reinartz

PRESIDENT, AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS

VICE PRESIDENT, ARMCO STEEL CORPORATION

A Biography

LEO FREDERICK REINARTZ, at the age of twenty-one, was a chemist in the laboratory of Armco Steel Corporation, a small company in Middletown, Ohio. This association, begun in 1909, has witnessed the growth of Armco from an organization of 800 employes and an annual production of 50,000 tons of ingots to a company with 28,000 employes and a production of 5,000,000 tons of ingots a year. Mr. Reinartz's contributions to his company's growth were recognized by his advancement through a succession of responsible positions, the most recent being his election as vice president in 1951.

An extracurricular honor came to him with his election as the 1954 president of the American Institute of Mining and Metallurgical Engineers. In 1952, he was the Institute's vice president; had served as chairman of its Iron and Steel Division; and was its 1943 Howe Memorial lecturer.

Leo, as his associates know him, was born in East Liverpool, Ohio, the first of seven children of the Reverend John Gottfried, D.D., and Sara Julia (Eppling) Reinartz. His father, a Lutheran minister in East Liverpool for forty-four years, was president of the local school board and acted as the arbiter in several labor disputes. His mother was a teacher and tutor of languages, specializing in English.

After graduating from the grade and high schools of East Liverpool, Leo matriculated at Carnegie Institute of Technology and was graduated in 1909, upon completion of a three-year course. A later thesis resulted in his being awarded a Bachelor of Science degree and a Professor's degree in Metallurgical Engineering by Carnegie Tech in 1923.

At the age of thirteen, Leo began part-time work as janitor in his father's church at a salary of $6 a month. During his college years, he worked at a variety of jobs on weekdays to earn his way, even though the tuition at Carnegie Tech in 1906 was only $35 a year. On Saturday afternoons, he was an assistant in the chemical laboratory. In his senior year, he taught chemistry at Tech's night school twice a week.

In 1915, he was transferred from the Armco laboratory to the East and Central Works as assistant superintendent of the open-hearth departments. Two years later, he was made open-hearth superintendent and, in 1923, was moved up to assistant general superintendent. Subsequent promotions included works manager, Hamilton plants, 1930; manager, Middletown and Hamilton plants, 1938; assistant vice president in charge of Middletown Division and coal mines in West Virginia, 1949; vice president, special operating development, in 1951, the position he holds today.

Mr. Reinartz was one of the founders, in 1925, of the National Open Hearth Conference; after serving as chairman for twenty years, he was elected to honorary life membership. The National Blast Furnace and Electric Furnace Committees are outgrowths of the success of the Open Hearth Conference. From 1951 through 1953, he was a member of the advisory committee of the Battelle Memorial Institute in its study of the electric furnace versus the open-hearth furnace. A member of the American Iron & Steel Institute, he was honored with its regional technical award in 1951. In 1953, he was chosen as the Andrew Carnegie lecturer for the Pittsburgh section of the American Society for Metals.

He holds a number of patents on the manufacture of steel in open-hearths, and presented a paper on the subject before the British Iron and Steel Institute.

Mr. Reinartz is a director of the American Institute of Mining and Metallurgical Engineers, the Bituminous Coal Operators Association, the Capital University in Columbus, Ohio, and the Ohio Traffic Council; he is vice president and a director of the Middletown Federal Savings and Loan Association. He is a former director and honorary life member of the YMCA in Middletown, having served as its president for three years; he was on the Board of Directors of the Butler County Automobile Club for five years. He is a trustee of Blue Cross — Hospital Care Corporation, Southwestern Ohio, and a former trustee of Middletown Hospital.

Other memberships include Advisory Council of the National Academy of Science, Washington, D. C.; Board of Regents of Capital University, Columbus, Ohio; Cincinnati Engineers Society; American Management Association; Ohio and National Chambers of Commerce; Tau Beta Pi, an honorary fraternity; and honorary membership in the Junior Chamber of Commerce of Middletown. He was the organizer of the Middletown Safety Council and its first president. His clubs are the Forest Hills Country in Middletown and the City in Hamilton. He is a member of the Bethlehem Lutheran Church in Middletown.

On September 16, 1916, Leo Frederick Reinartz married Mathilda S. Zix in East Liverpool, with his father officiating. Two daughters, Mathilda Graham and Helen Marie Duffin, live with their families in Parkersburg, West Virginia, and Palo Alto, California, respectively. Their only son, Leo Frederick Reinartz, Jr., at the age of twenty-five gave his life for his country on November 27, 1944, on Leyte, during the Philippine Island campaign. The Reinartz home is at 304 The Alameda, Middletown, Ohio.

When the demands of his extensive interests permit, Leo Reinartz finds enjoyment and relaxation in fishing, promoting athletic contests, and drawing.

Editorial

More Materials for the Nation's Stock Pile

According to a news release dated March 26, President Eisenhower has authorized a further stock-pile build-up of strategic materials, primarily by purchase of domestic metals by the Government. This action, deemed necessary to protect the Nation from possible loss of production in the event of enemy attack, was taken upon the recommendation of the cabinet committee on minerals policy headed by Secretary of the Interior Douglas McKay.

Estimates indicate that the new program will result in additional buying by the Government of 35 to 40 metals and minerals. Arthur S. Flemming, director of the Office of Defense Mobilization, declined to name the list of materials to be purchased at this time. He did comment, however, that "sums of considerable magnitude" will be spent and that the buying will be spread over a considerable period of time. Preference will be given to newly mined metals and minerals of domestic origin.

The President instructed Director Flemming to review present stock-pile objectives and to establish new long-term stock-pile goals. These goals are to be based on the assumption that supplies from domestic and foreign sources will not be available in the event of war. Also, all materials in the stock piles are to be upgraded and refined wherever possible, to be readily usable in an emergency.

In conclusion, the announcement said the new program is designed to help reactivate productive capacity and to alleviate distressed conditions in connection with domestic mineral industries that are an important element in the Nation's mobilization base.

Exploration Geophysics

Roy L. Lay, president of the Society of Exploration Geophysicists, recently announced the adoption of an expanded vocational guidance program by the society, including the publication of a booklet. The new booklet defines exploration geophysics and its opportunities, and tells how this comparatively young science has met the challenge to discover the earth's hidden treasures. Copies of the booklet will be distributed without cost to the 30,000 high schools throughout the Nation.

The increasing number of inquiries received at SEG headquarters in Tulsa from high-school vocational directors prompted the adoption of the new program and the publication of the booklet.

"College courses in geophysical sciences require a solid foundation in high school," Mr. Lay said. "We hope to assist geophysicists of the future by introducing them to their vocation in time for a good start."

Individuals or companies interested in this vocational guidance program may obtain sample copies of the booklet, "Careers in Exploration Geophysics" by communicating with the Society at 624 South Cheyenne, Tulsa 3, Oklahoma.

The 1954 Coal Convention

Mining men from all parts of the country will meet at The Netherland Plaza hotel in Cincinnati, Ohio, May 3 through 5, for all-out discussions of many problems of a critical nature that beset the coal mining industry today.

The program committee, headed by Edward G. Fox, president of The Philadelphia and Reading Coal and Iron Company, has done an outstanding job in arranging a series of general sessions and group meetings for thorough examination of ways and means to reduce costs and increase efficiency in the mining and selling of coal. Prominent leaders in Government and industry will present analyses of technical and economic subjects of major interest to the industry.

Advance reservations assure a record attendance of delegates at the 1954 Coal Convention.

Children and Blasting Caps

Since the spring of 1926, the Institute of Makers of Explosives, an association of manufacturers, has rallied the support of many agencies and societies throughout the United States in its effort to carry warnings to children of the dangers of playing with blasting caps.

The schools of the Nation, the Boy Scouts and Girl Scouts of America, policemen and firemen, radio stations, newspapers, magazines, trade journals, county agricultural agents, and many other organizations have helped to sound the warning. Their cooperation has been magnificent.

The Institute prepares and distributes colored leaflets, posters for bulletin boards, and articles for publication and broadcasting, all of which warn children of the dangers of playing with blasting caps. It also has available a 16-mm. motion picture entitled "Blasting Cap." This 15-minute sound-color film has been shown to thousands of children in schools and churches, scout meetings, and summer camps. The movie tells a story which grips the attention of boys and girls and presses home the warning. Requests for the loan of prints of this film should be addressed to the Institute of Makers of Explosives, 250 East 43rd Street, New York 17, New York.

With more children in the affected age group and more and more caps being used in our mines, quarries, and on construction jobs, it will be a bigger job this year than ever before to keep blasting caps away from children. Blasting cap accidents to our boys and girls must be eliminated. And they can be eliminated by thorough-going cooperation, especially by those who handle and use industrial explosives. Safeguarding our children is the responsibility of all.

TUNNEL BLASTING
On the Island of Toas

Skillful blasting of a complex rock formation enables a contractor to supply 1,200,000 tons of riprap for a breakwater project off the coast of Venezuela

H. V. BRENNAN*

THE discovery of oil in Venezuela was followed by greatly increased shipping activities on Lake Maracaibo, in the northwestern part of the country. Besides the normal use of the lake as a shipping lane, many tankers come to the dock at the city of Maracaibo to take on cargoes of oil, deliver them to refineries in Curacao and Aruba, and return for more oil. Because of the shallow depth of the lake water in the Maracaibo area only the smaller ocean-going tankers can be used. The government of Venezuela designated one of its branches, Instituto de Canalizaciones de Venezuela at Caracas, to investigate the problem and recommend a solution.

THE MARACAIBO AREA: The construction of a breakwater at Zapara Island and the dredging of a canal in the Maracaibo area will open up the shipping lane in the lake to large ocean-going vessels. Approximately 1,200,000 tons of broken rock will be produced in a quarry operation on Toas Island for use as riprap on the breakwater project.

The water in the rivers in the vicinity of Maracaibo drains into the lake, carrying with it large quantities of silt and sand which precipitate to the lake bottom. In the Gulf of Venezuela, the prevailing winds blow toward the southwest and the waves in the gulf stream flow in a southwest direction. At a point around San Carlos, heavy sand bars are formed when the water driven by the southwest winds in the gulf meets the silt-laden waters of Lake Maracaibo.

Following extensive surveys, the Instituto recommended the dredging of the canal from the west end of the Island of Zapara to extend southwesterly into the Maracaibo area. It also recommended the construction of a breakwater (malecon) to extend from the Island of Zapara for a distance of approximately 4 kilometers to prevent the dredged canal from refilling with sand and silt. The recommendations were approved by the government of Venezuela and bids were received from contractors for the work involved.

Breakwater Contract Awarded

Campenon-Bernard, S.A., a French company, was the low bidder for the job of building the breakwater and was awarded the contract. This company, in turn, awarded a subcontract to a Venezuelan company, Constructora Nacional de Tuneles y Carreteras, known locally as "Conticca," for the production of broken rock for use as riprap in the breakwater construction. Conticca's management personnel includes Dr. Carlos Guinand Baldo, president; Russell D. Antisdel, general manager; and Jorge Wrestler, field superintendent.

*Hercules Powder Company
380 Madison Avenue
New York 17, New York

The specifications for the production of the riprap were grouped into three classifications: Group A, 4,000 to 10,000 kilograms or more; Group B, 20 to 4,000 kilograms; Group C, run-of-quarry stone with less than 5 per cent rock dust.

Venezuela has an abundance of raw materials, with the exception of satisfactory building stone. The only available source for a supply of rock suitable for industrial uses is on the Island of Toas, located near the site proposed for the construction of the breakwater. For many years, rock on this island has been quarried and sold commercially as cement stone and crushed building stone in the Maracaibo area. The geology of the formation is complex, varying from a schistose type to limestone over shale, with numerous extrusive intrusions. It is interlaced with vertical and horizontal faults, and many mud seams. The caprock is very hard limestone. Following successive geological examinations, the Instituto announced that the rock formation on Toas Island was satisfactory for the breakwater construction.

Tunnel Blast Location Close to Shore Line

After considering various blasting techniques to produce the required riprap from the rock on the island, Conticca's management decided on the tunnel method of blasting. A location was chosen where the rock formation averaged 38 meters in height. The floor, or bench in front of the tunnel site, was only 35 meters wide.

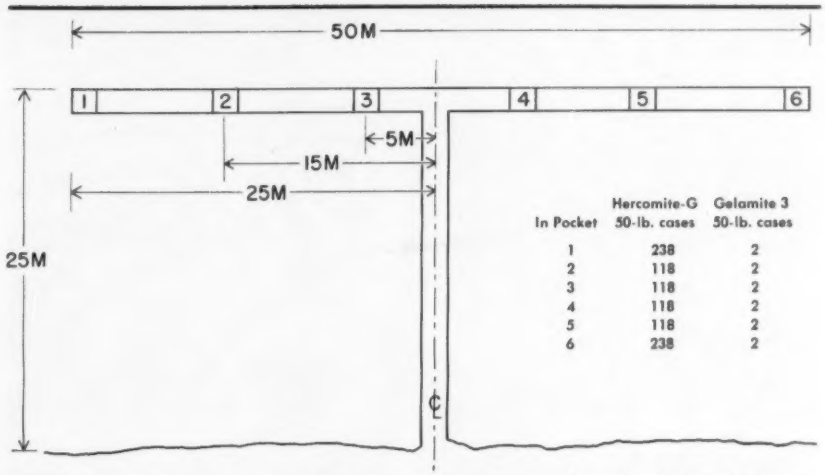
Before tunnel-driving operations could be started, it was necessary to remove a toe of weathered rock at the bottom and in front of the working face, about 20 to 25 meters deep and 15 meters high. After this had been drilled, blasted, and excavated, the tunnel was driven 1 meter wide and 1.2 meters high. Subsequent operations indicated that the height was too low. Future tunnels will be driven 1 meter wide and 1.8 meters high. The depth of the tunnel stem was 25 meters; the wings, or lateral tunnels, 50 meters overall. A total of 11 holes was drilled and blasted in each round in the tunnel, including a three-hole pyramid cut.

In driving the tunnel, the blast holes were drilled 5 ft. deep and each hole was loaded with 4½ cartridges of Gela-

DYNAMITE FOR THE QUARRY: A shipment of dynamite from the mainland of Venezuela is unloaded at a dock on Toas Island for delivery by truck to the site of Conticca's operations.

REMOVING TOE ROCK: Before tunnel driving operations started, weathered rock at the bottom of the quarry face was removed by blasting horizontal drill holes loaded with Gelamite 3.

POWER SHOVEL OPERATIONS: Two power shovels, a Lorain and a Lima, were used to remove the broken rock from blasts made in the weathered rock in the toe of the ledge.



In Pocket	Hercomite-G 50-lb. cases	Gelamite 3 50-lb. cases
1	238	2
2	118	2
3	118	2
4	118	2
5	118	2
6	238	2

TUNNEL LAYOUT: This diagram shows the plan of the tunnel layout, including the lengths of the stem and wings, the six pockets in the wings where the explosives were loaded, and the amount of dynamite loaded into each pocket.

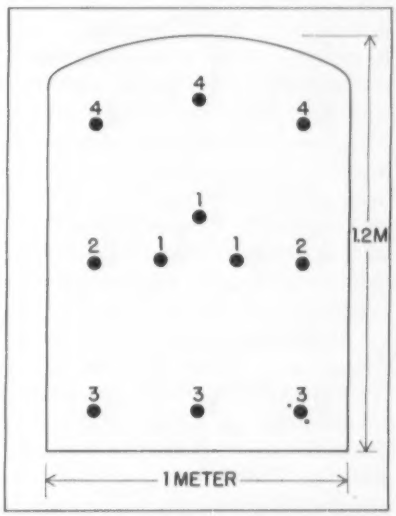
mite® 3, in 1¼ by 8-in. cartridges. Each round was fired with a blasting cap and safety fuse. Frequently, tunnel rounds broke rock to depths of 2 meters.

Loading and Firing 48,000 Pounds of Dynamite

With a three-man crew per shift, 22 days were required to complete the driving of the tunnel. A Gardner-Denver airleg drill equipped with Liddicot steel and bits was used to drill the holes. The blasted rock from a round was hand-mucked into wheelbarrows and transported outside the tunnel.

The dynamite charges loaded into the six pockets in the wings of the tunnel were a combination of 47,400 lb. of Hercomite®-G, in 8½-in. by 50-lb. cartridges and Hercomite Bag Powder, in 12½-lb. bags. A primer charge of 100 lb. of Gelamite 3, in 1¼ by 8-in. cartridges, was loaded with the explosives in each pocket. This made a total of 48,000 lb. of dynamite loaded. The placing of the explosives and the stemming of the tunnel required 60 hours of continuous work, using a seven-man crew and an eight-hour shift. Crushed stone fines were used as the stemming material.

The detonating circuit for the dynamite charges consisted of four reinforced Primacord* lines with crossties of Primacord in every 2 meters of fill and four Hercules® No. 6 Electric Blasting Caps taped onto the lines of Primacord. The leg wires of the caps were connected in series, using 200 ft. of No. 20 connecting wire and No. 14 duplex leading wire. The blast was fired with a 50-hole blasting machine.



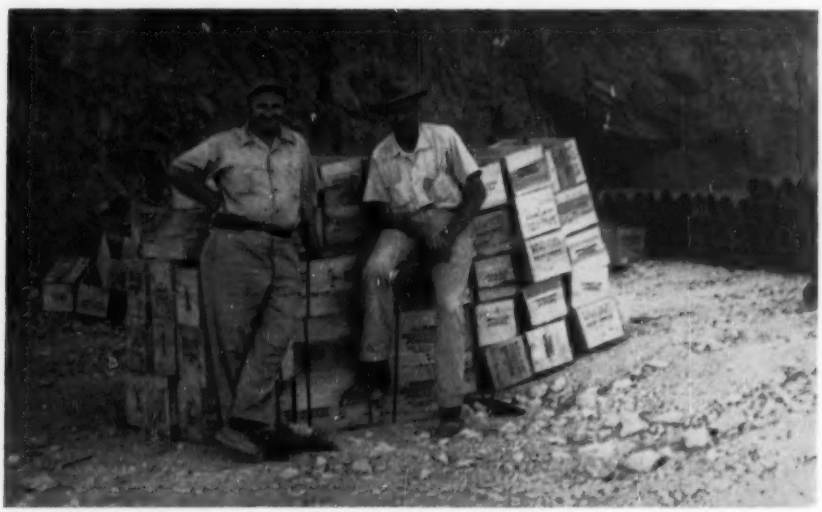
ROUND FOR DRIVING TUNNEL: In driving the tunnel, holes were drilled 5 ft. deep, each loaded with Gelamite 3 dynamite.

Some of the statistics of the blast were: volume of rock in place over the tunnel area, 48,000 cu. m.; dynamite loaded, 48,000 lb.; explosives loading factor, 1 lb. per cu. yd., shear factor, 2.9 lb. per sq. ft. of shear.

Excellent Blasting Results

The results from the tunnel blast were satisfactory to everyone associated with it. The estimated breakage was 96,000 cu. m. and the explosives factor, including overbreak, was 0.5 per cu. m. The expected percentage of the three groups of rocks specified in the contract was obtained. Some large boulders in the bank were reduced in size by secondary blasting.

As indicated previously, the quarry floor, or bench in front of the tunnel, was only 35 meters wide. Rock thrown beyond the bench and into the lake would be lost and not be paid for. Fortunately, only five pieces of rock



AT THE TUNNEL PORTAL: At the tunnel portal, left to right, H. V. Brennan, technical-service representative, Hercules Powder Company, R. D. Antisdel, Conticca's general manager, are shown enjoying a well-earned rest period.

*Reg U. S. Pat. Off. by The Ensign-Bickford Company

from the blast rolled off the bench and into the water.

The total amount of dynamite loaded in this tunnel blast was on the heavy side. In future blasts of this kind at this location, the explosives loading ratio will be reduced from 1 lb. to 0.9 lb. per cu. m.

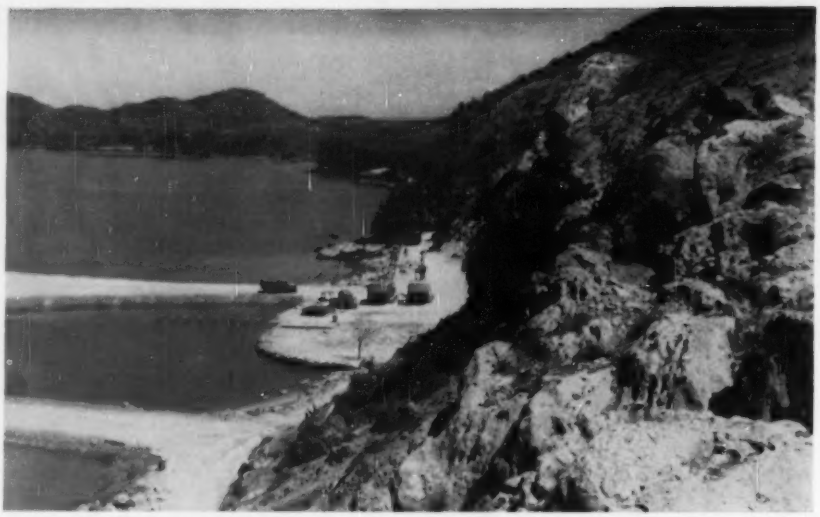
The contract did not specify the types of the explosives to be used. Following consultations, those selected were Hercomite-G, in 8½-in. by 50-lb. cartridges, for tunnel blasting; Hercomite Bag, in 12½-lb. bags, for tunnel and wagon drill blasting; and Gelamite 3, in 1¼ by 8-in. cartridges, for driving tunnels and for secondary blasting. The selection of the two grades and three sizes of dynamite provided excellent blasting results. It also eliminated the necessity for providing storage for several different types of explosives by the contractor.

Campenon-Bernard, S.A., the prime contractor, is handling the recovery of the rock blasted by Conticca. A crane is used to lift the Group A size out of the bank and to place it on a barge for transportation to the Island of Zapara. Groups B and C sizes are excavated by 2½-cu. yd. power shovels and dumped onto the barge. Upon arrival at Zapara, the rock is placed at the breakwater site.

Conticca's Equipment

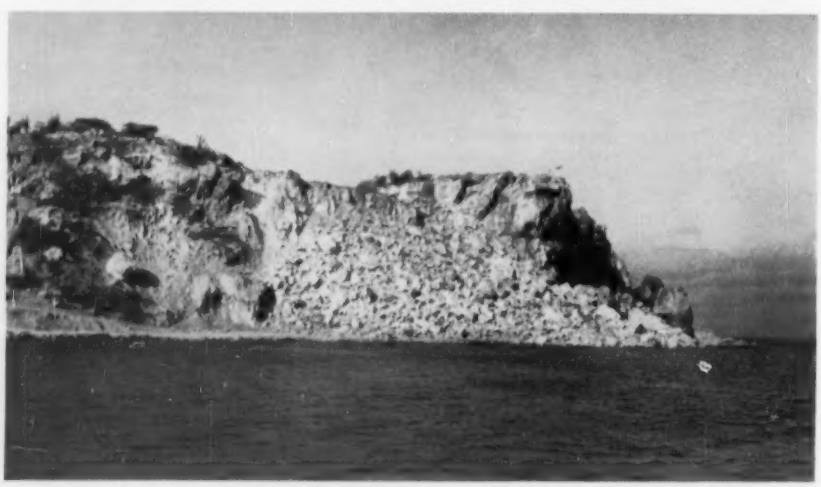
In excavating the blasted rock in the toe of the working face, preliminary to blasting the tunnel, Conticca used a ¾-cu. yd. Lorain shovel and a No. 318 Caterpillar tractor. Compressed air for the equipment was supplied by three Gardner-Denver 500-c.f.m. compressors. They were connected in series to fill a huge receiver tank. From the receiver tank, a 4-in. airline was extended along the length of the project. Cut-ins could be made into the airline wherever needed. A Worthington Model 105 portable compressor was also maintained for use when required. The drill units included Gardner-Denver wagons, jackhammers, and airlegs.

The total rock requirement of riprap for the construction of the breakwater is 1,200,000 tons. It cannot be supplied entirely by the tunnel method of blasting. Some will be produced by blasting in benches, using wagon drills to drill the required number of blast holes.



QUARRY FLOOR AND RAMP: The broken stone from blasts in the toe rock was used to build a quarry floor and a ramp for the operations of power shovels and a crane in excavating the rock broken from the tunnel blast.

BEFORE THE BLAST: This is how the ledge of rock over the tunnel looked before the blast was fired. The picture also reveals the narrow quarry floor between the ledge and the water.



AFTER THE BLAST: When the dust and smoke had disappeared from the area of the tunnel blast, the sloping bank of broken stone was revealed and everyone associated with the project expressed satisfaction with the results.

MINING COAL AT REEL'S COVE IN EAST TENNESSEE

The introduction of the panel system of mining, in which room depths were increased from 300 ft. to 2,100 ft., has upped production more than 50 per cent

OPERATIONS in the Reel's Cove Mine of Tennessee Products & Chemical Corporation, located approximately 15 air miles northwest of Chattanooga, Tennessee, are based on the extraction of coal from the Sewanee seam which averages 38 in. in thickness. The area allocated to the mine property contains 15,000,000 tons of coal and is part of the vast Whitwell reserve controlled by the corporation.

The Sewanee seam has been worked continuously since the early 1870's, when it was opened by English settlers at the south end of the Whitwell area. In 1929, the old Whitwell mines south of Reel's Cove were leased to the Black Diamond Coal Mining Company, with Carl McFarlin, a mining engineer (now the president of Tennessee Products & Chemical Corporation), as the director of operations. In his early days with the Black Diamond company, McFarlin pioneered the mechanical mining and the preparation of thin seams of east Tennessee coals. While directing the operations at Whitwell No. 1 and No. 9 mines, he successfully used the conventional room-and-pillar system which he had inherited.

Visualizing a completely mechanized mining program at the Reel's Cove property, McFarlin made plans to revolutionize the extraction of coal from thin seams. In the lower-left corner of the accompanying mine map extract, it may be observed that the room-and-pillar system was developed through the use of a combination of duckbill mechanical loading and hand loading on shaker conveyors. Rooms 300 ft. deep and 42 ft. wide were spaced on 50-ft. centers. No attempt was made to recover the coal remaining in the thin pillars.

Panel System of Mining

By a radical diversion from the usual mining practice, increasing the depth of rooms from 300 ft. to 2,100 ft., the output per unit per man on the overall average at Reel's Cove, including moving, has been increased more than 50 per cent. The panel system of mining, locally termed "continuous face," consists of four rooms abreast, spaced on 50-ft. centers, or two rooms abreast with two more rooms abreast following 100 to 200 ft. back. Panel mining eliminates the usual development of cross entries, which are necessary in the room-and-pillar method.

Blasting

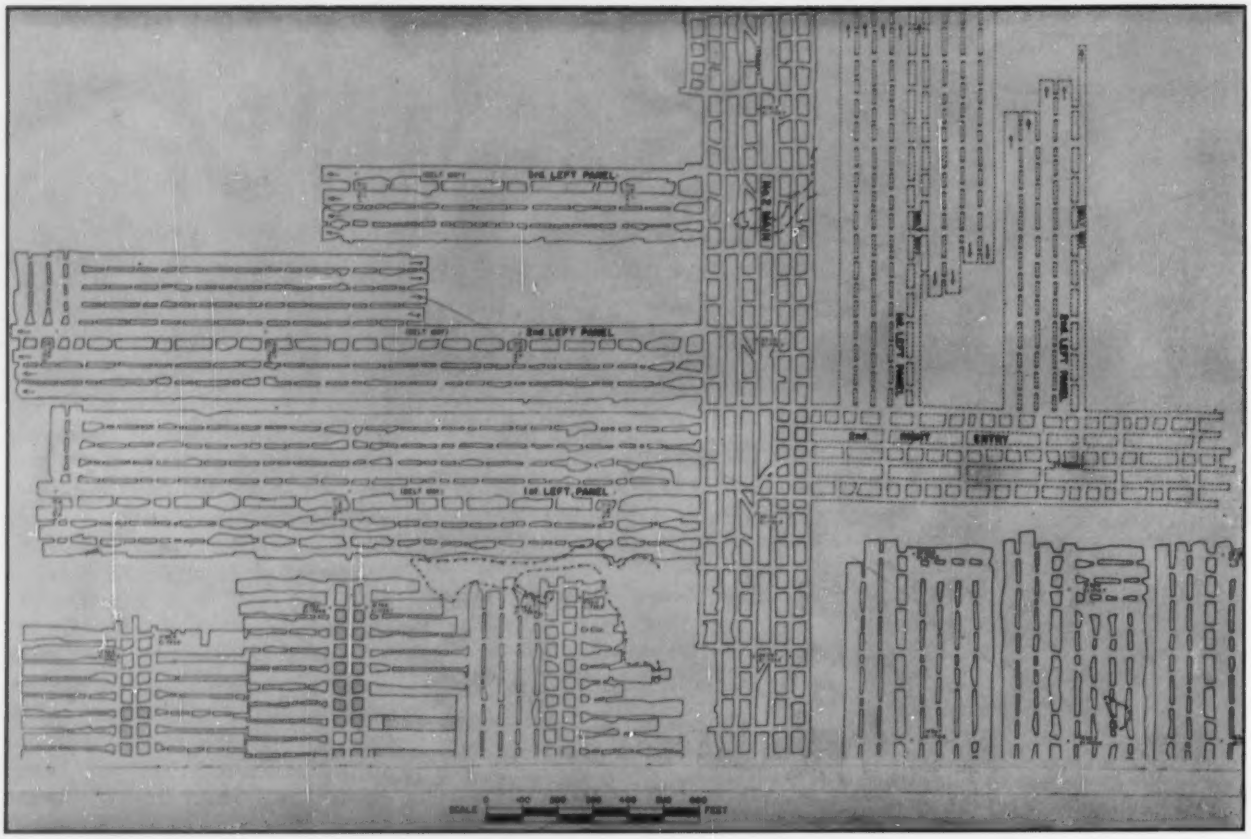
The coal at a working place is undercut with a Goodman 512 machine equipped with 8½-ft. cutter bars and bug dusters. Holes for blasting the coal in a room are drilled 7 ft. deep and spaced 7 ft. apart. Each drill hole is loaded with two or three standard-size cartridges of permissible powder. Blasts are fired with a permissible blasting machine. In firing the loaded holes, the explosives charge in the center hole is detonated first. Experiments with various blasting procedures in the mine proved that this method of blasting produces a better grade of coal, easier handling by the mechanical loading equipment, a better rib in the room, and no slabbing.

Recovering Blasted Coal

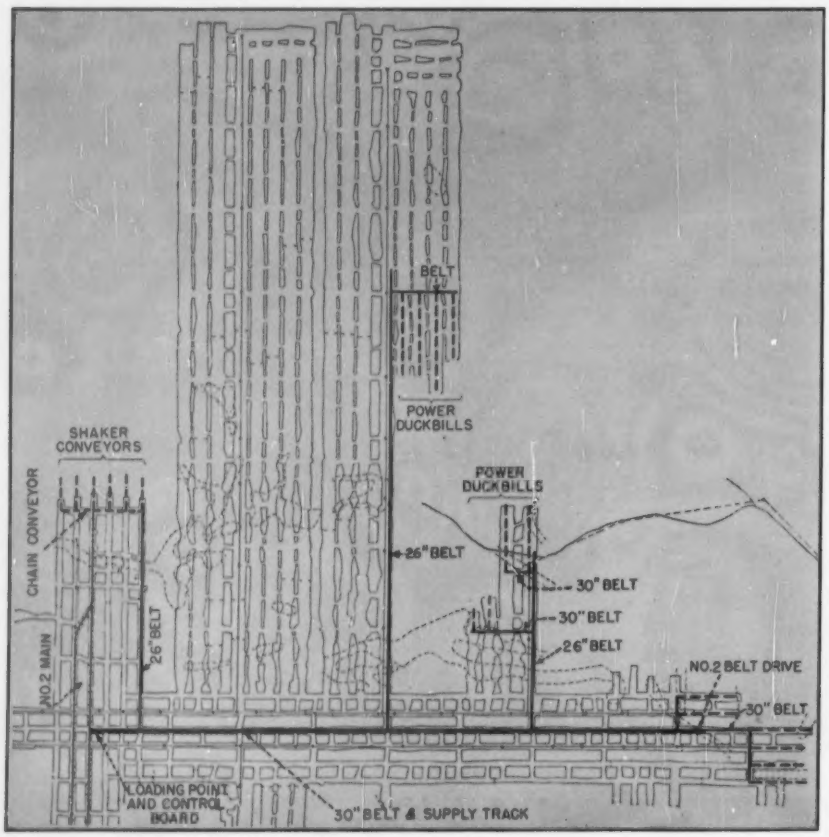
After blasts have been fired, coal is loaded mechanically from 12 places (3 panels) with Goodman 277 power duckbills onto conveyor pans which deliver the coal to a 30-in. crossbelt. The belt discharges onto a panel belt which carries the coal for discharge into 6-ton drop-bottom mine cars. The loaded cars are pulled by mine locomotives out of the mine to a 1,300-ton

BLASTING PREPARATIONS: Preliminary to firing blasts with permissible powder at a working face, the coal is undercut with Goodman cutter bars, and holes for blasting are drilled with electric hand drills.

DUCKBILL LOADING: At the center of a working face, blasted coal is being loaded mechanically with a Goodman power duckbill. At right, a coal machine is shown sumping up.



PANEL MINING SYSTEM: Extract from a map showing the panel system of mining in use at the Reel's Cove mine of the Tennessee Products & Chemical Corporation located at Whitwell, Tennessee.



MINING PLAN: Power duckbills are utilized in No. 2 mine to drive 2,000-ft. rooms. Two gathering belts per four-room section provide flexibility greater than can be realized from the use of one crossbelt section.

steel bin at the upper tipple. The coal is hand-loaded onto shaker conveyors in the main entry and the aircourse developments. These operations produce 250 to 300 tons in two 7-hour shifts. Production from the power duckbills in the two shifts averages 200 tons per unit, including moving time.

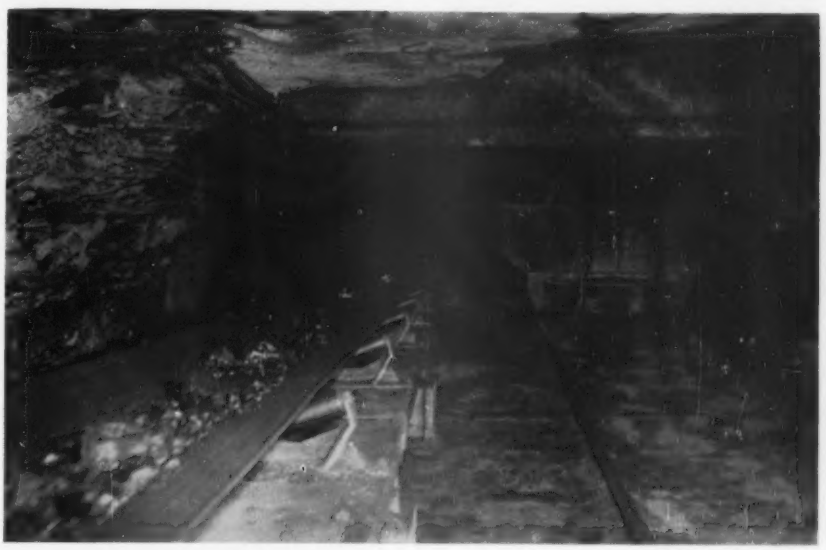
Operating Procedures

In using this continuous-face mining system, a 410 by 2,100-ft. panel is mined by driving four parallel rooms 2,100 ft. deep, then turning the power duckbills around and working four additional rooms back to the main. The rooms are 42 ft. wide and the pillars 8 ft., with the exception that on the advance a 30-ft. pillar is left be-

BELT CONVEYORS: Coal from a working place is discharged from a panel belt onto the "mother" or main belt for delivery to drop-bottom mine cars on the main haulage.

LOADING MINE CARS: At No. 2 loading station underground, coal is discharged from a gathering belt into a 6-ton mine car for delivery to a steel bin at the upper tipple.

tween rooms three and four for protection of the 26-in. sectional belt conveyor that is installed in room four as the advance is made. This sectional belt is removed as rooms five, six, seven, and eight are mined on the retreat. The shaker conveyors connecting the drive and the power units in the four rooms deliver coal to a 30-in. crossbelt, 200 ft. long. The crossbelt, in turn, discharges onto the sectional belt conveyor. When the power duckbills have advanced 250 ft., the crossbelt conveyor is moved up to a new position of equal distance. However, to provide greater flexibility, a modification of this plan is being tested in one section. In this modified plan, two crossbelts are used, one 100 ft. long for rooms three and four advanced ahead, and another 200 ft. long located 250 ft. back to handle the coal from rooms one and two.



DELIVERING SUPPLIES: The delivery of supplies is expedited over a track paralleling the main belt on an adjacent entry, with runaround tracks at various intervals. This feature keeps the belts open for continuous coal production and greatly enhances the efficiency of this modern mine.

With four rooms delivering to one crossbelt, all rooms must be advanced abreast. Otherwise, it is necessary to halt work in the leading rooms and wait for the rooms that lag to catch up as the time approaches for moving the crossbelt. The plan of utilizing two crossbelts results in two rooms delivering to the same belt most of the time. Therefore, only two rooms of the panel would have to be advanced abreast. In this method of mining, the shaker drives are moved approximately the same number of times as in the mining of 300-ft. rooms. However, each move requires less labor because all are in a straight line. The shakers are fitted with side-drive attachments to lower their discharge height, thereby reducing rock brushing in order to make headroom at the discharge end of the crossbelt. The power duckbill units

move automatically with the advance or retreat of the coal face, as the case may be. By reference to the mine map extract, it will be noted that power duckbill units retreating in rooms five, six, seven, and eight are in position to minimize an all-out move along the aircourse to the next succeeding panel, rooms one, two, three, and four. Generally, the saving in full-unit moves with 2,100-ft. rooms, as compared to 300-ft. rooms, is 14 against 72.

Development

An eight-entry system is used for mainline development with secondary track haulage on four- and six-entry systems, depending on the life and the anticipated tonnage from such secondary entry development. In either event, a panel of four producing places

REMOTE CONTROL BOARD: All underground operations are controlled electrically from this board located at the loading point approximately 850 ft. inside from the haulage portal.

UNIQUE CONVEYING SYSTEM: This view of Reel's Cove "Little Grand Canyon" shows the conveying system extending from the upper tipple near the mine entrance to the preparation plant in the valley below, a drop in elevation of 1,000 ft.

is "necked" at right angles in conjunction with entry progress. To provide for the transportation of coal from panel rooms and from the production of the entry aircourse development, 30-in. conveyor belts are placed in adjoining entries parallel to the track heading. These 30-in. belts deliver coal to loading stations spaced at 2,000 to 2,500-ft. intervals on the mainline outby high-top development and bypass all deadwork. Sidetracks are provided at each loading station to facilitate the handling and exchange of trips in trains of 20 steel drop-bottom mine cars, each of 6-ton capacity. Top rock (brushing) is loaded with a combination Myers-Whaley loadertrack cleaner. After the mine cars are loaded at the central loading station, they are hauled by electric locomotives to the upper tipple. Here the cars are dumped automatically as they pass across a steel bin having a storage capacity of 1,300 tons.

Unique Conveying System

The coal is conveyed down the mountainside to a tipple, located in the valley some 1,000 ft. below, by a combination of several methods. It is brought down an almost perpendicular bluff by means of a steel tube 5 ft. in diameter and 140 ft. long. The flow in the tube is regulated with a vibratory feeder which discharges onto a retarding conveyor of the rope-and-button type, 800 ft. long. At the foot of

REEL'S COVE SUPERVISORS: Left to right, Edgar Hixson, mine foreman; Archie Reeves, Dan Steel, section foremen; Ralph Rankin, mine foreman; H. A. Daffron, superintendent.

the conveyor, the coal is discharged onto a 2,000-ft.-long 42-in. belt conveyor. This conveyor consists of two sections of 1,000 ft., each with separate drives. At the foot of this conveyor, a surge bin of 100-ton capacity is located. The bin is provided with a spiral chute to reduce degradation. The coal is unloaded from the surge bin by a vibratory feeder onto a 36-in. belt conveyor which carries it to the tipple, where it is discharged onto shaker screens for grading. The tipple is equipped with two rubber-belt picking-and-loading booms for handling the larger sizes. There are four loading tracks and adequate tailtracks for the storage of railroad cars. Equipment has been installed for crushing lump and egg coal, depending on market conditions.

From the storage bin at the mine entry to the preparation plant, the entire conveying system is electrically interlocked and is operated by remote control at the preparation plant. However, emergency controls are provided along the system.

Transporting Supplies

Supplies are transported to the belthead inside the mine in specially constructed supply cars. From the belthead they are carried to the face of the panels on the room belts. The use of the main haulage as a supply track eliminates use of the "mother" or main belt and leaves it open for continuous operation on all shifts.

At present, Reel's Cove mine produces coal on two shifts only, using the third shift for supplying the various panels. However, the panels can be supplied on the two production shifts without materially hampering the output of coal.

Geology — Roof Control

The immediate roof is slate, or sandy slate, ranging in thickness from a few inches up to 50 ft. The main roof consists of massive sandstone and laminated shales. The total thickness of the overburden varies from 100 to 450 ft. The existence of firm or sandy slate formations simplifies the burden of roof control. Crossbars and screw jacks are used at duckbill faces to protect workmen. As the faces are advanced, conventional post timbering replaces temporary controls. With 80 per cent extraction in the panels, the time element in roof-control action cannot be disregarded. In this case, the panel system again has the advantage over the room-and-pillar system. It also is of interest to note that no trace of gas has been found in the Sewanee seam at the Whitwell area.

Modern Mining Triumph

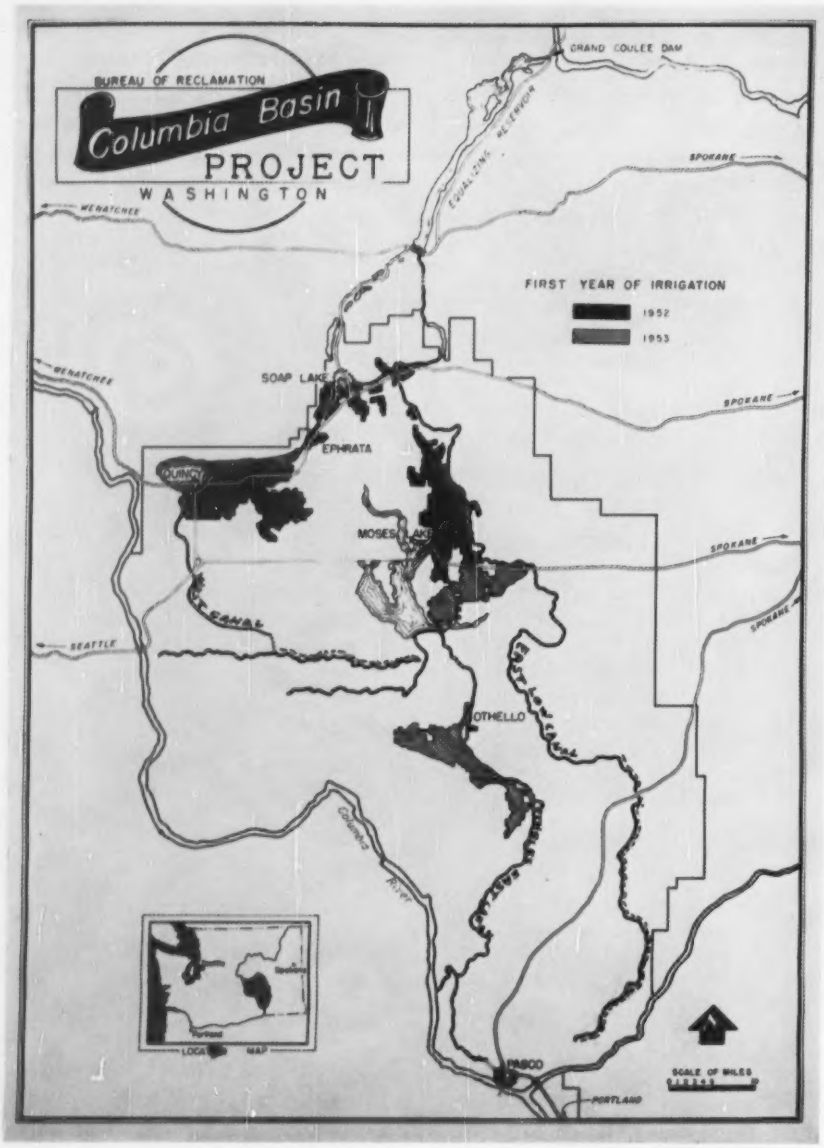
Reel's Cove mine is a modern triumph in mining procedure. It is one of the most efficient coal mines in Tennessee and its safety record is outstanding. Each year, the mine substantially improves both operating costs and production tonnages. Much of the credit for these records is attributed to the able direction of H. A. Daffron, superintendent, a veteran in the working of the Sewanee seam, and to W. J. Travis, general manager of the Whitwell operations.

LOWER TIPPLE: The lower tipple screening and preparation plant is equipped with shaker screens for grading the coal, belt picking, and loading booms for handling the larger sizes, and a crusher to reduce lump and egg coal to smaller sizes, depending upon the market.

THE COLUMBIA BASIN PROJECT IN TRANSITION AND GROWTH

The bringing of water to irrigate 2,500,000 acres of desert land has intensified farming activities, roadway and bridge construction, and electric power line installations

CHARLES F. THOMAS*



This map shows the present and future canal system in the Columbia Basin and the areas irrigated in 1952 and 1953. The broken lines paralleling the canals indicate the West Canal now under construction and a section of East Low Canal scheduled for future construction.

THE mammoth construction program of the U. S. Bureau of Reclamation on the Columbia Basin project in east central Washington is rapidly passing from its spectacular stages. The force of industrial explosives, which served so well in speeding the excavation for Grand Coulee Dam, the tunnels, canals, and auxiliary dams in the area, is being replaced by the multiple efforts of human and electrical energy in the continuing development of the Basin region. A guaranteed supply of water for irrigation has brought about rapid farmland development and heavily increased crop production. The transition is as amazing in its way as was the construction work.

For more than 20 years, the work done in building Grand Coulee Dam and related units of the Columbia Basin project received worldwide publicity. Thousands of people watched the amazing progress. Engineers and students from foreign countries came to study the methods of Bureau engineers and United States construction companies in building what once was called the most fanciful of undertakings. They returned to their homelands with new enthusiasm and knowledge of modern American skills and engineering techniques.

Like a Three-Ring Circus

The ramifications of the program for the Columbia Basin project could well be compared with a three-ring circus. Adjacent to the main highways and near the larger towns in the area, various units of construction equipment were kept busy performing many

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Ephrata, Washington

intricate operations in digging and lining wide canals. Long siphons seemed to crawl like snakes across rugged coulees. Some canyons had special sideshows with the blasting of a tunnel through a basalt ridge or the building of a dam to impound and lift water for the irrigation of dry desert land.

Like a circus that folds its tents and quietly slips away from town after an exciting performance, power shovels, draglines, dozers, and fleets of trucks have been moved away from the towns and the upper basin into the wide reaches of the 2,500,000-acre expanse of the three counties in which the project lies. At this time, new construction activities are found only by searching for the distant swinging booms of big shovels or draglines, or by following the roads along the completed canals or laterals into the more remote regions where units of work are in progress.

The year 1953 closed with the completion of 167 miles of the principal canals and more than 725 miles of the smaller canals and laterals ready to deliver water to 186,000 acres of land. Frenchman Hills tunnel, 9,300 ft. long and 16 ft. in diameter, previously described in the March-April, 1952, issue of THE EXPLOSIVES ENGINEER, was holed through in April, 1952, and will become an operating segment of the system when another 28-mile section of the canal is completed in 1954, and water is diverted through it.

Constructing Final Section Of East Low Canal

The completion of the 130-mile-long East Low Canal will provide a supply of water for 252,000 acres of land. Work on the construction of the fifth section, the final 30 miles of this canal, was started in mid-1953, under contract with J. A. Terteling & Sons of Boise, Idaho. Strata of columnar and fractured basalt are being encountered on six or more miles of heavy excavation of the right-of-way. Some of the cuts have had to be excavated to a depth of 55 ft. An overburden of top soil, varying from 1 to 4 ft. deep, is stripped before drilling operations are begun. Drilling is done with wagon drills, using detachable tungsten carbide bits on the drill steel. Air for the operation of the drills is supplied by four or more heavy-duty portable compressors. Because of the seamy basalt formation, extra care is required in drilling to prevent the drills from getting stuck in the holes. Despite the difficulties caused by varying rock conditions, excellent drilling progress is being obtained.

ROCK DRILLING: A battery of wagon drills at work in a rock cut on the fifth section of East Low Canal. Despite the variable basalt formation encountered excellent progress is made.

A pocket is made in the bottom of each drill hole by "springing" it with a charge of 40 per cent gelatin dynamite. This pocket permits the loading of a heavier, more concentrated charge of dynamite at the base of the explosives column in each hole to get better breakage in primary blasts. Bag powder is used in the primary blasts, on a loading ratio of approximately 1 lb. of powder to 1 cu. yd. of rock in the solid.

Railroad Track Locations Complicate Work Progress

Work on the fifth section of the East Low Canal is further complicated by

READY TO BLAST: Wire connections between loaded drill holes in a 400-ft. section of East Low Canal are inspected before the blast is fired. Broken rock in the foreground is from a blast previously fired. The canal will be 26 ft. deep at this location.

CALICHE FORMATION: On one of the sections of East Low Canal, the contractor used two D8 tractors to pull a heavy-duty three-toothed ripper through a caliche formation.

FUTURE EXCAVATION: A view of the right-of-way and the roadway along the line of future excavation for the fifth section of the canal. Some cuts have to be excavated to a depth of 55 ft.

PIPE FOR A SIPHON: Sections of reinforced steel and concrete pipe 54 in. in diameter are lined up along a lateral area of Potholes East Canal for the installation of a siphon 1⅛ miles long.

numerous canal crossings under the tracks of the Great Northern, the Chicago, Milwaukee & St. Paul, and the Northern Pacific railroad companies. These railroads have crisscrossing arterials into all of the rich wheat-producing lands of central and eastern Washington. The Bureau of Reclamation's program requires that this fifth section of East Low Canal be ready for water late in the autumn of 1954, and supply water to farm lands in 1955.

Unlike most other irrigation projects in which water is supplied only to lands below canals, the Columbia Basin project lifts water by means of electrically operated pumps to bring it to more than 47,000 acres of land which were opened to irrigation during the first two years of operation. At present, 186 pumps varying from 3 to 2,000 hp. are capable of pumping an estimated 200,000 acre-feet of water during the irrigating season. Pumps and control equipment, protected against dust, rain, and snow, are installed in many isolated locations. These pumps require no operators except for starting and the checking of oil levels, and to occasionally clear floating debris from the screens protecting the pumps.

During 1953, contracts for major construction jobs representing a total cost of approximately $18,000,000 were completed, or were under way as the year ended. Much activity will continue in 1954, the volume of work being governed by the amount of money appropriated by the present session of the Congress. The successful progress of this ambitious program of construction, resulting from years of planning and work by the Bureau of Reclamation, has demonstrated that the money invested to date has been wisely spent and that increasing returns will be realized in the years to come.

The Coming of Water Spurs Farming Activities

All of the activities which follow the bringing of water to a new reclamation area seemed to explode into action at once. Dozens of tractors leveled sagebrush-covered lands. Laterals and head ditches were extended by the farmers to further distribute water to thirsty crops. Wells were drilled for water for domestic use because canal water, although clear and sparkling,

was unsafe to drink and is not available during winter months. Houses were built, and varied units of equipment necessary for tilling the soil were moved to the new farms. Contracts were let for the construction of roads and bridges to provide travelways between farms and towns. The stringing of power lines was accelerated to supply energy for both farm use and the operation of the many pumps on the project.

In 1952, water was available for 66,000 acres of land. More than 27,000 acres were planted to crops valued at $4,700,000. In 1953, an additional 58,000 acres were available for irrigation. The additional acreage planted to crops brought the total to about 70,000, with the crops valued at $9,500,000. The principal crop items have been beans, sugar beets, potatoes, and onions. Irrigated fields have produced as much as 90 bushels of wheat an acre.

What is considered to be the most modern beet sugar factory in the world was constructed near Moses Lake in 1953 by the Utah & Idaho Sugar Company. In October, this $7,000,000 factory began the processing of 2,000 tons of sugar beets a day. Heavy tonnages of coal from mines in Washington and thousands of tons of limestone are required to provide power for the operation of the factory, and for the treatment of sugar beets in the refining processes.

Towns Expanding Rapidly

The former small towns of Ephrata, Moses Lake, Quincy, and Othello are figuratively "bustin' at the seams." All have striven to keep pace with the growth of the farming areas. New residential and business districts are continually expanding and numerous million-dollar school buildings have been erected recently. Distributors of equipment, machinery, and materials are transacting huge volumes of business annually as the new farms develop.

In a section of the country where poor roads were the rule rather than the exception, people of this new empire in the northwest were faced with serious transportation problems. But, again, with all the splendid coordination found in the program of a big-time circus on a well-planned tour, the Bureau of Reclamation engineers, the Washington State Department of Highways, and officials of the three counties affected have labored effectively

WEST CANAL: Water for the desert in a completed concrete-lined section of West Canal, Columbia Basin project, 90 ft. wide at the top and 30 ft. wide at the bottom. The water is checked to the level shown by a gate structure and check three miles to the west.

to produce a practical road system for the new farming region. Much bridge construction was anticipated and included in the original canal construction contracts. The first biennium ending June 30, 1953, found road construction nearly abreast with overall project development. During 1952, approximately 150 miles of secondary highways were constructed in Grant County. This construction performance was duplicated in 1953. Adams and Franklin County forces each constructed sizable mileages during the year. Plans call for the construction of more than 200 miles of secondary roads within Grant County this year. The State Department of Highways will begin an enlarged road program throughout the basin in 1954. These roads will constitute the primary highways of the region and the combined system will provide easier access to shipping terminals, markets, schools, and cities. The new road locations are planned so that no farm will be more than two miles from a bituminous-surfaced highway.

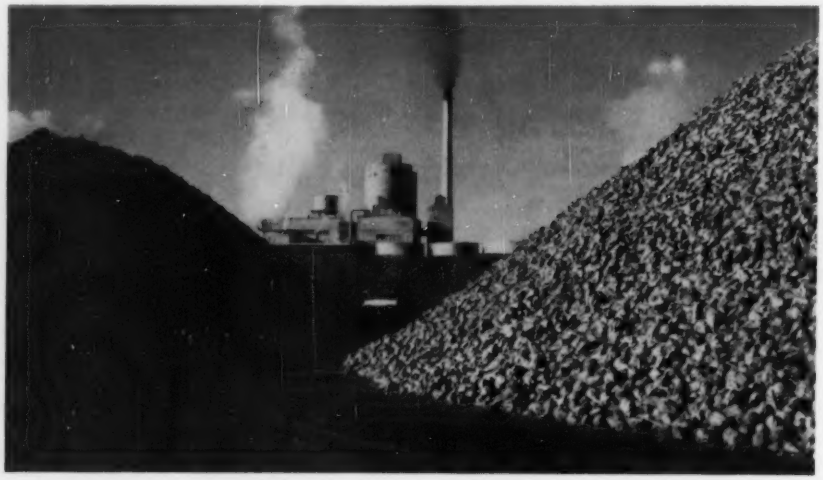
Passage of Bond Issue Accelerates Road Construction

Financing for road construction was established by the Washington State legislature in 1951, with the passing of a bond issue for $5,000,000. These bonds were supplemented by $820,000 of Federal Aid Secondary Funds. The issue of bonds covers a five-year period with the proceeds from their sale divided in equal biennial allocations of $2,960,000. The bonds are to be redeemed over 25-year periods by limited payments from annual gas tax allocations. On many sections of the proposed routes heavy excavation will be involved. As a result, large quantities of industrial explosives will be used.

In the regional planning, supplying electrical power was as important as the needs for good roads. Extensive studies by power agencies in the three counties, in conjunction with Bureau engineers, have resulted in a methodical extension of facilities into each of the areas as the need occurs. The Public Utility District built 130 miles of lines in Grant County in 1952, serving a total of 7,776 accounts. In 1953, the number of accounts served was increased by 1,163. The Big Bend

(Continued on page 58)

RINGOLD WASTEWAY: Waste water from the Potholes East Canal drops 517 ft. into Ringold Wasteway, a reinforced concrete chute 2,400 ft. long, and is discharged into the Columbia River near Richland, Washington. The water has traveled across country 150 miles.



COLUMBIA BASIN SUGAR BEETS: Sugar beets from farms in the Basin area are stockpiled near the new $7,000,000 factory of the Utah & Idaho Sugar Company near Moses Lake. The plant processes 2,000 tons of sugar beets a day.

BABCOCK PUMP LIFT: These ten units at Babcock Pump Lift west of Quincy, Washington, will supply water to more than 14,000 acres of land above West Canal. Control cabinets are visible along the right wall of the building. The pumps require very little attention.

DITCH BLASTING
Reclaims Useless Ohio Farmland

Blasting a series of ditches with dynamite converted 75 acres of land along Pone Run, east of Midvale, Ohio, to fertile soil for general farming purposes with a minimum expenditure of money and time

W. F. MILLER*

For a quarter of a century, farmers along Pone Run, directly east of Midvale, Ohio, had been unable to utilize 75 acres of land extending through their properties. This acreage, covered with soft creek-bottom muck, trees, and heavy brush, was useless for farming purposes, or even as pasture land. A ditch that had been dug through the section some years ago had become filled with sediment and overgrown with willows. The overflow of water in the area spread across the land on both sides of the old ditch.

In June, 1951, the land owners and the officials of Columbia-Southern Chemical Corporation and Davidson Mining Company joined in a cooperative plan to correct the situation. The chemical company operates a coal mine at the head of the run, and the mining company conducts a clay-stripping operation in the valley.

THE ORIGINAL DITCH: A ditch dug through the section some years ago had become filled with sediment and overgrown with willow trees and heavy brush, causing water to overflow onto adjoining farmland. A cooperative plan to correct the situation was adopted.

A 6,500-ft. Ditching Program

Investigations developed that the original ditch had to be cleared, straightened, and deepened for a distance of about 3,000 ft., and new ditches totaling approximately 3,500 ft. in length had to be provided. Group meetings of the property owners resulted in a decision to do the work by blasting with dynamite. The program stipulated that the ditches were to be approximately 5 ft. deep, 6 ft. wide at the bottom, and 15 ft. wide at the top.

Details of Blasting With Ditching Dynamite

Work began with staking off the center line of the old ditch. This was done by attaching twine to stakes and

PREPARING TO BLAST: Men at work loading 1¼ by 8-in. cartridges of ditching dynamite in holes 3 ft. deep on 1¼-ft. spacings, along the center line of the old ditch location. In this area, trees and a thick growth of briars made normal work progress difficult.

*Hercules Powder Company
Pittsburgh 22, Pa.

DITCHING WITH DYNAMITE: At the instant of detonating a propagated blast of 350 lb. of Hercules Ditching Dynamite, the photographer snapped this action picture of muck, water, broken bits of trees, sediment, and heavy brush high in the air.

placing the stakes in the ground along the center line. By the use of crowbars, holes averaging 3 ft. deep, spaced on 1¼-ft. centers, were punched into the soft, mucky soil along the center line. Each hole was loaded with one cartridge of Hercules® Ditching Dynamite, size 1¼ by 8 in. When more depth and width of ditch were desired, two cartridges of dynamite were loaded into each hole. Additional dynamite cartridges were placed under trees and heavy brush encountered along the old and the new ditch locations. The charges of dynamite loaded into the holes were fired by the propagation method, that is, by the detonation of an electric blasting cap which had been placed in one of the cartridges loaded into one of the holes in a ditch line. The water in the ground acted as a conductor for carrying the wave of detonation from the explosion of the one primed cartridge to the dynamite cartridges loaded in adjoining holes, and so on down the line of loaded holes. Each successive blast was fired with a Hercules 10-cap blasting machine.

Useless Acres Converted To Fertile Soil

Completion of the project required the firing of numerous individual blasts. The heaviest blast comprised 216 holes, with each hole loaded with two cartridges. A total of 350 lb. of ditching dynamite was loaded and fired in this blast, including the cartridges placed under trees and heavy brush along the ditch line.

Most of the property owners participated in the work details, or were interested spectators. Everyone was delighted with the excellent results obtained, commenting particularly on the speed and economy with which the job was accomplished. The original ditch was restored and new lateral ditches were made. The 75 useless acres were converted to rich, fertile soil for general farming purposes with a minimum expenditure of money, effort, and time.

DRAINAGE PROBLEM SOLVED: Blasting with dynamite produced 6,500 ft. of deep, wide ditches to provide adequate drainage through the Pone Run area and reclaim 75 acres of idle farmland. Everyone associated with the project was delighted with the excellent results obtained.

SINKING A CIRCULAR AIR SHAFT THROUGH WEST VIRGINIA ROCK

Ames Mining Company sunk a shaft 13.5 ft. in diameter and 392 ft. deep through variable rock formations to provide air to its drift mine in the 30-in. Sewell seam of coal at Fayette, West Virginia

ENNIS A. NAEVE* and PAUL MORTON†

AMES MINING COMPANY operates a drift mine at Fayette, West Virginia, in the 30-in. Sewell seam of the New River coal field. To provide additional air for its underground mining activities, the company started work in the summer of 1951 by sinking a circular shaft. Specifications called for the shaft to have an outside diameter of 13.5 ft. and to extend 392 ft. deep into an existing entry in a mainline pillar in the mine. The point of sinking was determined by transit survey.

The formations through which the shaft had to be sunk were sedimentary rocks consisting of an alternate series of sandstone, sandy shale, and shale, with an aggregate thickness approximating 178 ft., 120 ft., and 94 ft., respectively. More than 100 ft. of the sandstone deposit was an extremely hard, gray, crystalline formation.

The presence of numerous horizontal bedding planes in some of the rock formations caused blasts to break to them. This resulted in an excess of oversized material, particularly from blasts fired in the sandstone formation. No timber supports were required in sinking the shaft.

The normal operating crew numbered five men from the company's personnel, three of whom worked in the shaft. The fourth man acted as a combination hoist operator and drill sharpener, and the fifth man was the supervisor of work details. All activities associated with this shaft-sinking job were under the direction of Paul Morton, mine superintendent; Leslie Martin, outside foreman; and Thomas W. McGuire, project engineer.

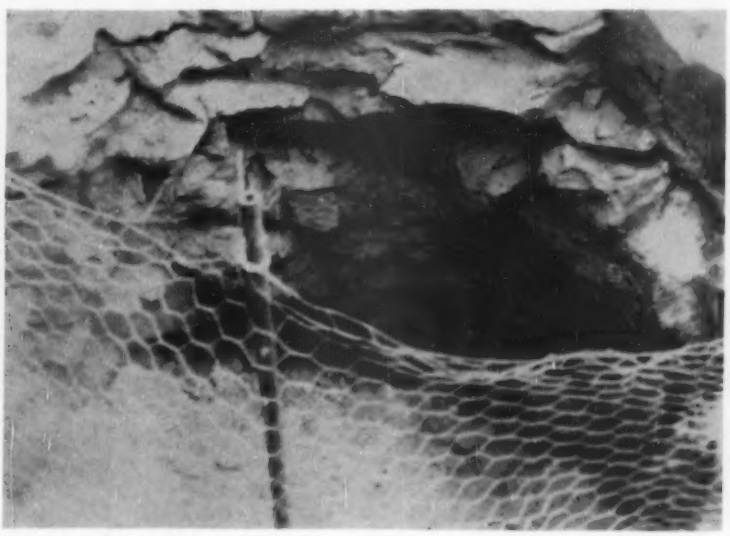
Preliminary Drilling

Before actual shaft-sinking operations began, two diamond drill holes were drilled to a depth of 402 ft., extending to a point just below the coal horizon. Two additional diamond drill holes were bored 130 ft. deep to a point below a major source of water inflow encountered in drilling the first two holes. After the completion of the drilling of the four holes, all of them were grouted. Then followed the drilling of an 18-in. churn drill hole into the strata and into the mine workings for the following purposes: (1) to drain water encountered in the shaft down the hole and into a mine sump from where it was pumped to the outside; (2) to permit the dropping of blasted rock broken to a maximum size of minus 18-in. down the hole and into a bin at the bottom, from where the

*Partner, Bennett-Naeve-Thomas Engineering Co., Oak Hill, W. Va.

†Former superintendent Ames Mining Co., Fayette, W. Va.

SHAFT TRANSPORTATION: A hoist bucket raised and lowered men and materials up and down the shaft.

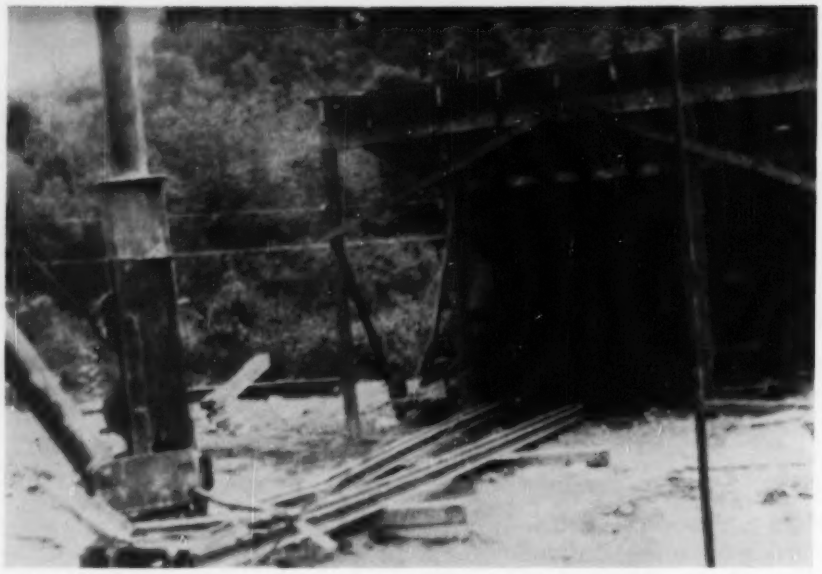


SHAFT ROCK: Rock formations through which the shaft had to be sunk were sedimentary deposits consisting of alternate series of sandy shale, shale, and sandstone.

broken rock was hauled outside in mine cars and dumped; (3) to provide an additional free face for blasting in the shaft which contributed to better rock fragmentation; and (4) to accelerate the rapid drawing off of smoke from blasts down the shaft and into the mine return airways.

The rate of the water flow from the 18-in. hole into the mine working proved that the pregrouting was only partially successful. Consequently, three more holes, each 125 ft. deep, were drilled and grouted. At this depth the desired distance beneath the water inflow was realized.

The second grouting attempt accomplished only a little more waterflow stoppage. Nevertheless, the sinking of the shaft was started without further grouting efforts in an attempt to meet a specified job-completion date.



HOISTING EQUIPMENT: A two-drum Flory hoist and a stiff-legged derrick with two hoisting sheaves comprised the major equipment used in hoisting operations.

Shaft Crew and Equipment

A round of holes for blasting was drilled by two of the shaft workmen, while the third prepared the charges of explosives and the inert material for stemming the loaded holes. When not busy with hoisting duties, the fourth man sharpened drill bits near the collar of the shaft so that he would be quickly available to operate the hoist when the shaft-bell signal would ring. Additional men were employed as needed to haul supplies and to help in concreting operations.

The drill rig used in the shaft was an Ingersoll-Rand drill boom equipped with two D.A. 30 drifters. The rig was supported at its drilling position by a center hoist rope. Basically, it consisted of two drifters mounted vertically at the ends and on the underside of a horizontal steel beam. Two blast holes were drilled at one time. The positioning of the drills with respect to the shaft center was controlled with air motors.

When drilling in shale, Ingersoll-Rand 1-in. or 1¼-in. by 6-ft. drill steel with 2-in. steel Jackbits was used. When drilling in sandstone and sandy shale, Timken rock bits or Carset bits were employed.

By means of a two-drum Flory hoist and a stiff-legged derrick equipped with two hoisting sheaves the drill rig was suspended in the shaft center by one hoisting rope, while the hoist bucket was operating on another hoist cable offset from the center line. Compressed air for the operation of the equipment at the shaft was delivered by an Ingersoll-Rand 75 B.H. Type 40 compressor equipped with a 3 by 8-ft. air receiver.

Blasting Procedure

Holes for blasting in the shaft were drilled 2 in. in diameter and 6 ft. deep. A round consisted of three concentric rings of holes drilled around the 18-in. churn drill hole as a center. The inner and middle rings of holes were drilled vertically, while holes in the outer ring were fanned out to break a 13½-ft.-diameter hole.

The number of holes in the rings and their spacings were varied to meet the rock conditions encountered. In shale, the time required to drill 48 holes 6 ft. deep averaged about four hours. In the crystalline sandstone, drilling time for 60 holes averaged seven hours.

Normal blasting procedure was followed and the drill holes were loaded with Hercogel®-A dynamite in 1¼ by

DIRECTOR OF OPERATIONS: All activities associated with the sinking of this air shaft project were under the direction of Paul Morton, mine superintendent.

8-in. cartridges. In the shale, the loading ratio was approximately 2.6 lb. of explosives to 1 cu. yd. of rock in place. In the sandstone, the loading ratio ranged up to 6.1 lb. of explosives per cu. yd. of solid burden. The charges of dynamite were primed with Hercules® Short-Period Delay Electric Blasting Caps, numbers 0 to 4 inclusive, and were stemmed with sand to the collar of the holes. The leg wires of the blasting caps were connected in series parallel and blasts were fired with a conventional 50-hole blasting machine.

Following a blast in the shale formation, approximately one-half of the broken rock mucked itself down the 18-in. churn drill hole. The remainder was hand-mucked by three men in about one and a half hours.

Blasting Results

In the sandstone, blasting results were not as favorable as were those in the shale. The major source of trouble was the bridging over of the 18-in. churn drill hole by large slabs of rock. Quite often, it required as much worktime to uncover and open the hole as it did to hand-muck the round – three to six hours in sandstone.

The seamy, bedded nature of the sandstone did not lend itself consistently to satisfactory breakage by any of the various blasting rounds tried. None of the hole-opening methods used were successful in a majority of attempts. However, the adoption of a "breaker bundle" of 15 cartridges of Hercogel-A dynamite suspended in the 18-in. drill hole to a depth of about 3 ft. – one-half the depth of the drill round – and detonated with a No. 1 Short-Period Delay Cap, was quite effective in breaking the slabs that had been pushed into the hole by primary blasts. Unfortunately, this procedure was not adopted until the shaft-sinking operations were nearly completed.

Concrete Lining Operations

When the shaft had reached a depth of 45 ft., sinking operations were stopped and the shaft collar was concreted to a depth of 30 ft. from the top. The collar projected 2 ft. above the ground level to prevent the accidental pushing of objects into the shaft. The collar was concreted to finish with an inside diameter of 12 ft. and a wall thickness of 9 in. A corrugated Armco tunnel liner was used as a form for the concrete. The mix was lowered in the hoisting bucket to the desired location and dumped from the bucket into the form.

At a depth of 100 ft. a water inflow of 30 to 40 gallons per minute was encountered. Sinking was continued to the 140-ft. level to make room for the placement of concreting forms. A concrete ring was then poured at the 100-ft. inflow area in an effort to stop the flow of the water. The results were not entirely successful. Additional concrete rings were poured at weak rock sections and other points of water inflow as the shaft was driven downward.

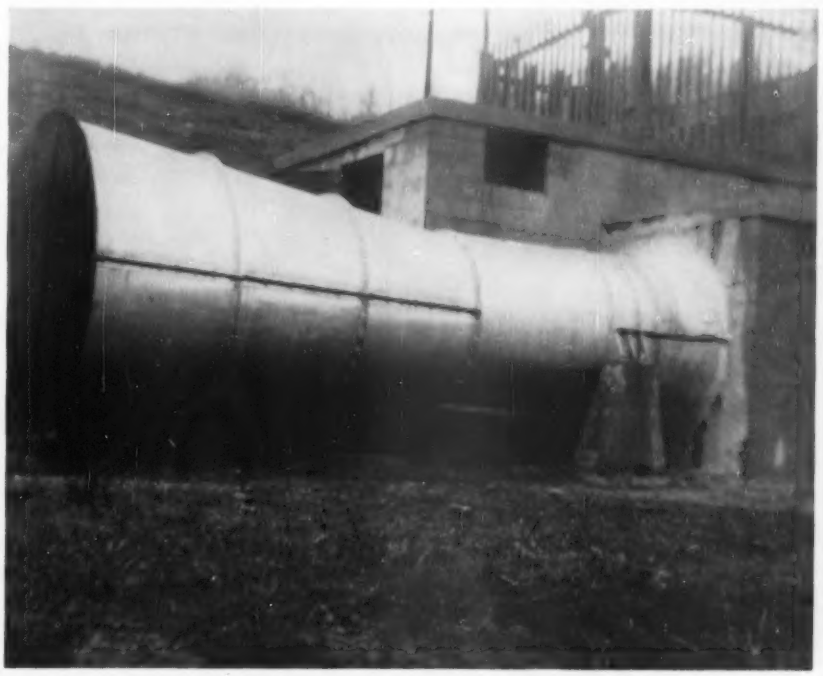
The use of a homemade folding umbrella, 11 ft. in diameter, was of great help in protecting workmen from the never-ending rain in the shaft. The umbrella was attached to the hoisting cable and could be raised or lowered to any desired position. Loose wall rock was scaled periodically from a working platform which was raised and lowered by the center hoisting cable.

Grouting

After the shaft had been sunk into the mine workings, five additional grout holes were drilled around the circumference of the shaft to a depth of 125 ft. Subsequent grouting practically stopped all water inflow and the shaft wall was then comparatively dry. This permitted the use of a Jetcrete gun to spray a gunite layer on unconcreted areas. This protected the wall rock from the weathering action of the ventilating air.

The 18-in. churn drill hole was highly satisfactory as a passageway for the removal of water and rock from the shaft bottom, as well as a means of disposing of smoke from the blasts. However, when the hole was covered or bridged over with slabs of rock following some of the blasts in the sandstone formation, mucking-out operations were slowed considerably. The substitution of a 24- or 30-in. churn drill hole for the 18-in. hole would, in all probability, have made this hole-bridging problem a minor item in work progress.

A more intensive pregrout program designed to lessen the inflow of water in the shaft would have contributed to greater speed and efficiency in concrete and gunite operations, and established more comfortable working conditions in the overall shaft-sinking activities at the mine property.



EXHAUST FAN: A view of the exhaust fan installed on the surface after the air shaft had been "holed through" into the mine workings.

The Columbia Basin Project

(Continued from page 52)

Electric Co-Operative constructed 105 miles of lines in Adams and Franklin Counties in the past two years, with 92 miles built previously into the irrigated areas near Pasco. The Washington Water Power Company has made extended installations in the basin.

Safety on the Columbia Basin project has been stressed in a positive manner. Because of the large number of contractors involved in the ramified units of work, the introduction of educational methods was necessary in many instances. First-aid training programs were instituted during the peak years of construction. An exceptional safety record was established on the project in tunnel driving. Bacon tunnel, 26 ft. in diameter and more than 10,000 ft. in length, and Frenchman Hills tunnel, 16 ft. in diameter and 9,300 ft. in length, were completed without fatal accident. Both tunnels were driven through fractured or columnar basalt formations.

New Show to be Continuous

Population trends into the Pacific Northwest indicate that the amazing developments which occurred in 1952 and 1953 will continue. Except for California, the State of Washington has had the greatest increase in population of any of the western states in the past ten years. Increasing demands for water will necessitate the construction of another large tunnel near Coulee City within another six years. This tunnel will be similar to Bacon tunnel in size and length and will parallel it 200 ft. to the north through the 10,000 ft. of basalt formations.

The scene has changed in two short years and the first exciting performers have left the arena of action. However, the new show, the Columbia Basin in transition and growth, is even greater and the program will be continuous.

NEWS NOTES

METHANE GAS DETECTOR

A new instrument that will continuously sample the atmosphere of coal mines for methane gas has been announced by Mine Safety Appliances Company, Pittsburgh, Pa.

Designed primarily for use in mine-ventilation systems, the instrument takes samples of return air and automatically analyzes them to detect presence of methane gas. The manufacturer claims that the new instrument can sound an alarm, visible and audible, when the concentration of methane is present in the sample.

Methane gas, being colorless, odorless, and tasteless, is the product of decomposition of organic matter. Pockets of this highly explosive gas may be encountered in coal seams, both bituminous and anthracite.

This new instrument is intended to supplement small hand-operated, battery-powered methane detectors and testers, and the familiar flame safety lamps now being used in coal mines. These instruments are employed for spot-checking face workings, breakthroughs, air courses, and haulageways.

GARDNER-DENVER WAGON DRILL

A new wagon drill has just been announced by Gardner-Denver Company of Quincy, Ill. The complete new unit, known as Gardner-Denver Model URM, consists of a new drill wagon with dual hydraulic lift, 4-in. drill, and RM chain feed.

The new drill wagon is equipped with two hydraulic lifts which quickly raise or lower the U-bar while the drilling mast is being maneuvered into position.

The drill wagon carries the chain feed and the heavy-duty Gardner-Denver 4-in. drill. This drill, it is said, combines fast and powerful hammer action with the ability to keep the steel rotating in bad ground. According to the manufacturer, this steady rotation, plus hole cleaning at full-line pressure and a powerful pull for extracting steel, means that the URM can save deep holes which otherwise might be lost in broken ground.

A single drill control handle, conveniently located within the operator's reach on the chain feed, operates all drilling, blowing, and hole-cleaning actions. The URM accommodates 8-ft. steel changes as standard. Additional details may be obtained by writing to the manufacturer.

CLEVELAND TRENCHER

A two-color, eight-page catalog-type bulletin on the Cleveland Model 110 trencher is available for distribution by The Cleveland Trencher Company. A rugged, compact, highly productive trencher, the Model 110 is a performance-proved machine capable of digging all types of trench from 12 to 24 in. wide and up to 5½ ft. deep, according to the manufacturer.

The bulletin features the wide versatility of the Model 110 trencher. Numerous job applications with the trench-size range are illustrated. The Cleveland company's design and construction features are accurately described in the center spread which also contains a numbered outline photograph showing the position of important parts.

Action photographs from various types of trench jobs demonstrate the all-around usability of the Model 110. Complete dimensions and specifications are given on the back cover. They include a table of optional bucket sizes, which shows both standard and maximum cutting widths for each option.

Copies of the bulletin, No. S-116, may be obtained by writing to Cleveland Trencher Company, 20100 St. Clair Avenue, Cleveland 17, Ohio.

BULLETINS ON P&H DIESELS

A new series of two-color bulletins covering the full line of P&H Diesel Engines is announced by Harnischfeger Corporation, Diesel Division. Printed on two sides of an 8½ by 11-in. sheet handy for filing and reference purposes, the new literature gives condensed information and specifications on this line of two-cycle diesel engines. There is a separate bulletin for each diesel with pictures of each model or engine and power unit. Marine diesel engines are covered separately. All models, from 20 to 138 hp., two, three, four, and six cylinders, are included in the new series of specification bulletins. A complete set may be obtained by writing Harnischfeger Corporation, Diesel Division, Crystal Lake, Ill.

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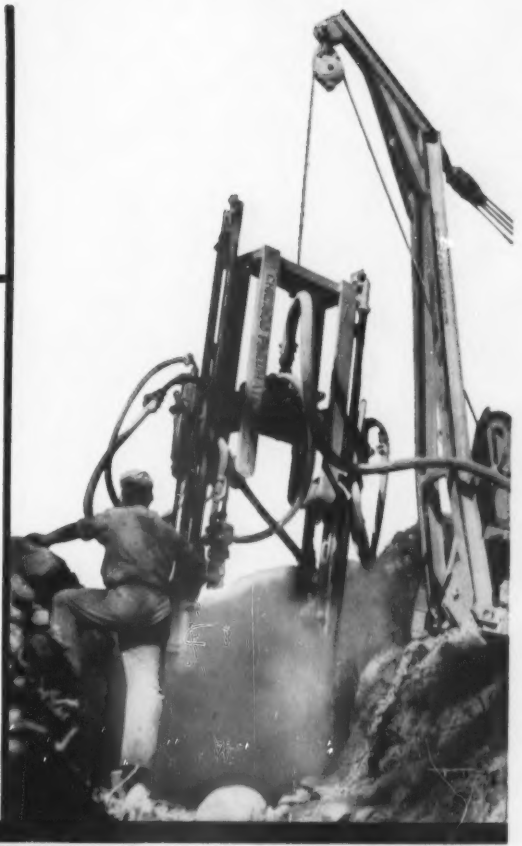

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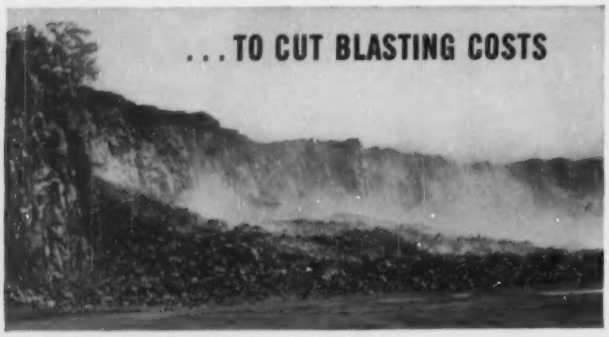

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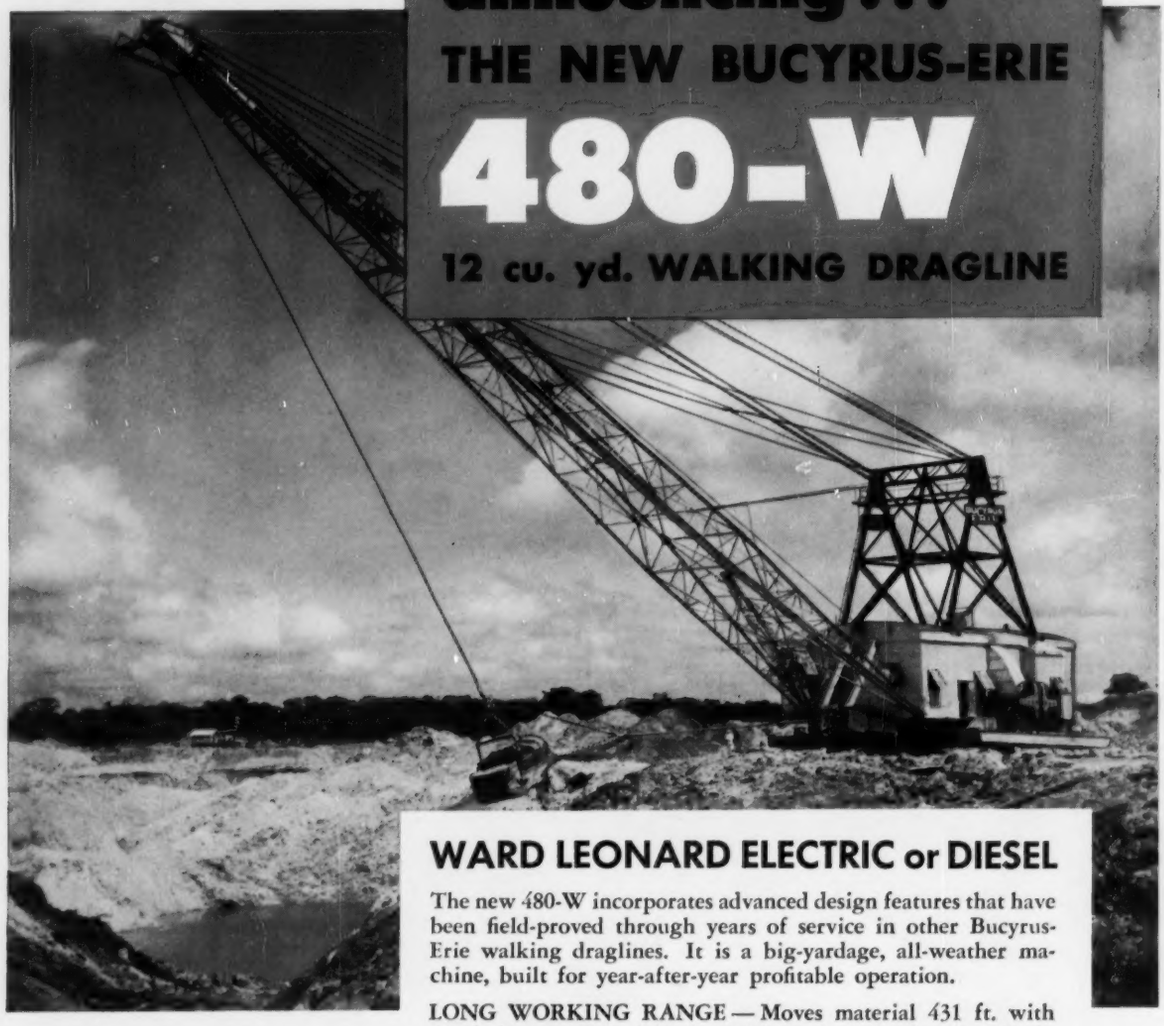

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